Topic: Estimating with scientific notation

Question: Use scientific notation to estimate the value of the expression.

$$\frac{(51{,}685 \times 10^{4})\,(3{,}295 \times 10^{-16})}{519{,}000}$$

Answer choices:

A $\approx 3 \times 10^{10}$

B $\approx 3 \times 10^{-10}$

C ≈ 5

D $\approx 6 \times 10^{2}$

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Solution: B

Since we're estimating, we'll begin by rounding each of the whole numbers to one significant figure.

$$\frac{\left(51{,}685 \times 10^4\right)\left(3{,}295 \times 10^{-16}\right)}{519{,}000}$$

$$\frac{\left(50{,}000 \times 10^4\right)\left(3{,}000 \times 10^{-16}\right)}{500{,}000}$$

Next, we'll express each of the whole numbers in proper scientific notation.

$$\frac{\left((5 \times 10^4) \times 10^4\right)\left((3 \times 10^3) \times 10^{-16}\right)}{5 \times 10^5}$$

Combine powers of 10 in the numerator.

$$\frac{\left(5 \times (10^4 \times 10^4)\right)\left(3 \times (10^3 \times 10^{-16})\right)}{5 \times 10^5}$$

$$\frac{\left(5 \times 10^{4+4}\right)\left(3 \times 10^{3+(-16)}\right)}{5 \times 10^5}$$

$$\frac{\left(5 \times 10^8\right)\left(3 \times 10^{3-16}\right)}{5 \times 10^5}$$

$$\frac{\left(5 \times 10^8\right)\left(3 \times 10^{-13}\right)}{5 \times 10^5}$$

If we separate the whole numbers from the powers of 10, we get

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$$\frac{5 \times 3}{5} \times \frac{10^8 \times 10^{-13}}{10^5}$$

$$3 \times \frac{10^{8+(-13)}}{10^5}$$

$$3 \times \frac{10^{8-13}}{10^5}$$

$$3 \times \frac{10^{-5}}{10^5}$$

Applying the quotient rule for exponents to the powers of 10, we get

$$3 \times 10^{-5-5}$$

$$3 \times 10^{-10}$$

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Topic: Estimating with scientific notation

Question: Use scientific notation to estimate the value of the expression.

$$\frac{0.00247 \times 10^{-14}}{421{,}091 \times 10^{6}}$$

Answer choices:

A $\approx 5 \times 10^{-29}$

B $\approx 5 \times 10^{30}$

C $\approx 4 \times 10^{-20}$

D $\approx 6 \times 10^{20}$

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Solution: A

First, we'll express each of the decimal numbers in proper scientific notation.

$$\frac{0.00247 \times 10^{-14}}{421{,}091 \times 10^{6}}$$

$$\frac{(2.47 \times 10^{-3}) \times 10^{-14}}{(4.21091 \times 10^{5}) \times 10^{6}}$$

Next, we'll combine the powers of 10 in the numerator and denominator separately:

$$\frac{2.47 \times (10^{-3} \times 10^{-14})}{4.21091 \times (10^{5} \times 10^{6})}$$

$$\frac{2.47 \times 10^{-3+(-14)}}{4.21091 \times 10^{5+6}}$$

$$\frac{2.47 \times 10^{-3-14}}{4.21091 \times 10^{5+6}}$$

$$\frac{2.47 \times 10^{-17}}{4.21091 \times 10^{11}}$$

Now we'll round each of the decimal numbers to the nearest whole number.

$$\frac{2 \times 10^{-17}}{4 \times 10^{11}}$$

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If we separate the whole numbers from the powers of 10, and apply the quotient rule for exponents to the powers of 10, we get

$$\frac{2}{4} \times \frac{10^{-17}}{10^{11}}$$

$$0.5 \times 10^{-17-11}$$

$$0.5 \times 10^{-28}$$

We still need to express this in proper scientific notation. To get just one digit to the left of the decimal point in 0.5, we need to move the decimal point one place to the right, so the exponent will be -1.

$$0.5 = 5 \times 10^{-1}$$

Now we'll multiply that by 10^{-28}.

$$(5 \times 10^{-1}) \times 10^{-28}$$

$$5 \times (10^{-1} \times 10^{-28})$$

$$5 \times 10^{-1+(-28)}$$

$$5 \times 10^{-1-28}$$

$$5 \times 10^{-29}$$

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Topic: Estimating with scientific notation

Question: Use scientific notation to estimate the value of the expression.

$$\frac{\left(62{,}314 \times 10^{-20}\right)\left(0.000356 \times 10^{7}\right)}{\left(400{,}000 \times 10^{6}\right)\left(.000000821 \times 10^{-18}\right)}$$

Answer choices:

A 7.5

B 7.5×10^{2}

C 7.5×10^{20}

D 7.5×10^{200}

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Solution: A

First, we'll put each of the decimal numbers in scientific notation.

$$\frac{(62{,}314 \times 10^{-20})\,(0.000356 \times 10^{7})}{(400{,}000 \times 10^{6})\,(.000000821 \times 10^{-18})}$$

$$\frac{(6.2314 \times 10^{4} \times 10^{-20})\,(3.56 \times 10^{-4} \times 10^{7})}{(4 \times 10^{5} \times 10^{6})\,(8.21 \times 10^{-7} \times 10^{-18})}$$

Since we're estimating, we'll round the decimals to the nearest whole number and combine the powers of 10.

$$\frac{(6 \times 10^{4+(-20)})\,(4 \times 10^{-4+7})}{(4 \times 10^{5+6})\,(8 \times 10^{-7+(-18)})}$$

$$\frac{(6 \times 10^{-16})\,(4 \times 10^{3})}{(4 \times 10^{11})\,(8 \times 10^{-25})}$$

If we separate the whole numbers from the powers of 10, and apply quotient rule for exponents to the powers of 10, we get

$$\frac{6 \cdot 4}{4 \cdot 8} \times \frac{10^{-16} \cdot 10^{3}}{10^{11} \cdot 10^{-25}}$$

$$\frac{24}{32} \times \frac{10^{-16+3}}{10^{11+(-25)}}$$

$$0.75 \times \frac{10^{-13}}{10^{-14}}$$

$$0.75 \times 10^{-13-(-14)}$$

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$$0.75 \times 10^{-13+14}$$

$$0.75 \times 10^{1}$$

Change this answer into proper scientific notation, by moving the decimal point to the right one place, and decreasing the exponent by 1 in return.

$$7.5 \times 10^{0}$$

$$7.5 \times 1$$

$$7.5$$

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